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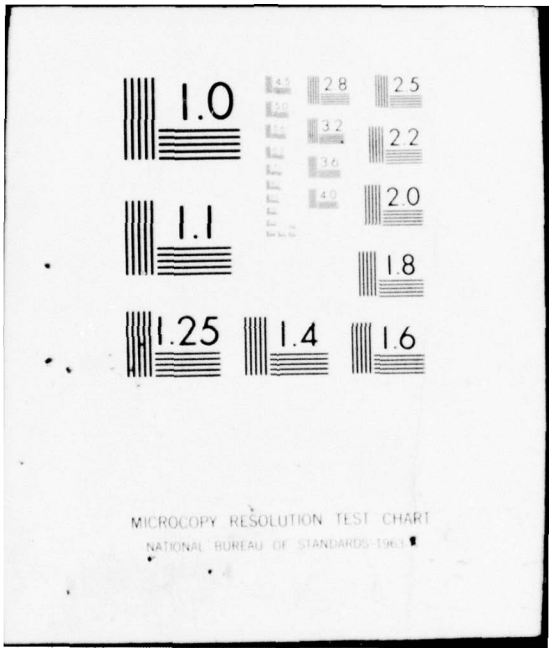
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# FLEET ISSUE REQUIREMENTS LIST/ FLEET ISSUE LOAD LIST MODEL DOCUMENTATION

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## OPERATIONS ANALYSIS DEPARTMENT

NAVY FLEET MATERIAL SUPPORT OFFICE
Mechanicsburg, Pennsylvania 17055

Report 126

# FLEET ISSUE REQUIREMENTS LIST/
# FLEET ISSUE LOAD LIST
# MODEL DOCUMENTATION

REPORT 126

PROJECT NUMBER 971256

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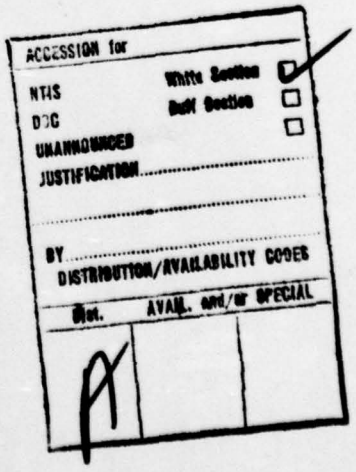
## ABSTRACT

Upon the outbreak of hostilities, it is anticipated that ships on station and those immediately ordered to sea will experience a period when support will only be available from on-board stores and those of the Mobile Logistics Support Force. To prepare for this possibility, a projected demand-based material requirement is computed annually to support surface ships in a geographical area for a stipulated period. The geographical area quantity is subdivided into individual load lists for combat stores ships and for selected, strategically located shore activities. For these purposes, the secondary items of supply are divided into three categories: APA, NSA-equipment-related, and NSA-non-equipment-related. A model determines range of items to be carried and variable depth of stock by line item, to obtain a projected supply effectiveness goal. Sample calculations are provided.

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## I. INTRODUCTION

The FIRL (Fleet Issue Requirements List) is an element of the Navy's PWRR (Prepositioned War Reserve Requirement) which is authorized for support of the surface fleet by reference 1. This FIRL includes all categories of secondary items required to support approved fleet forces except ammunition, bulk petroleum, subsistence, ship's store stock, and aviation cognizance material.[1] It is subdivided into a LANTFIRL (Atlantic Fleet FIRL) and a PACFIRL (Pacific Fleet FIRL), each of which is computed annually by FMSO (Navy Fleet Material Support Office). Each fleet FIRL is a defined range and depth of material computed to provide a specified level of resupply support of the total deployed forces for a 90 day endurance period without replenishment. The FIRL computation is essentially based on historical fleet demand. The FIRL is augmented to include items outside the demand-based range under certain limited and specific conditions outlined in reference 1.

The FILL (Fleet Issue Load List) is that portion of

---

[1]OPNAVINST C4080.11A also authorizes an aviation FIRL based on AVCAL requirements. This report does not consider the aviation FIRL.

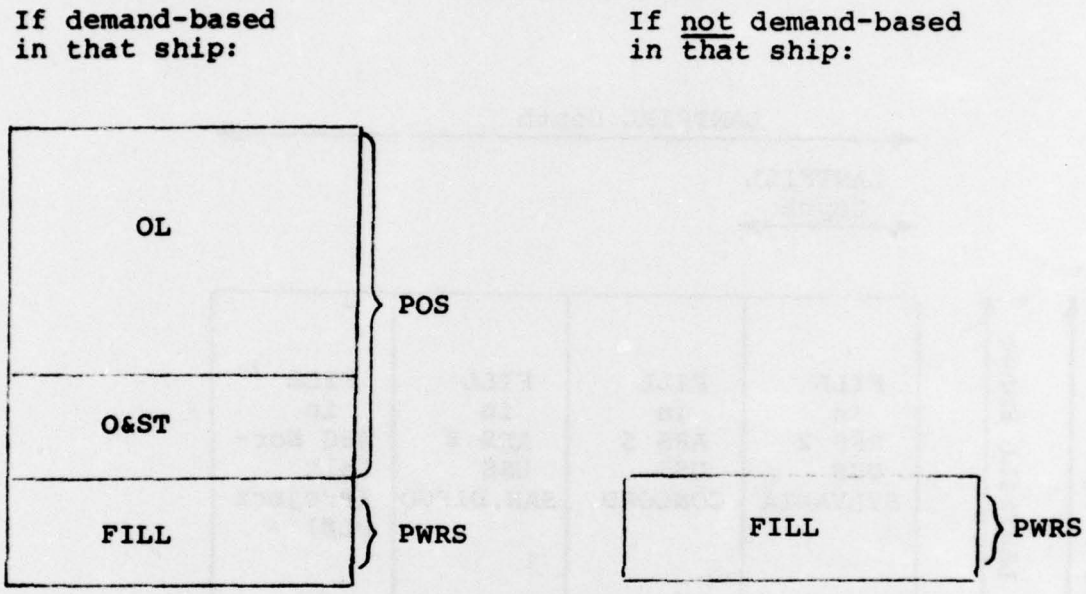
the fleet FIRL which is positioned in a given Combat Stores Ship (AFS). As such, the FILL range and depth are included in the Navy's PWRR. The FILL establishes the range of material which fleet customers may expect to acquire from the AFS, and therefore, becomes a shopping catalog. This catalog is published annually for each fleet by FMSO in conjunction with the annual fleet FILL computation. It is identified as Chapter IV of the fleet CARGO (Consolidation Requisitioning Guide-Overseas).

The FILL depth is augmented in the AFS by POS (Peacetime Operating Stocks). Reference 2 provides detailed criteria for these augmented loads. FIGURE I illustrates the depth of stock carried in an AFS for FILL items with or without demand experience in that AFS.

The FILL range and depth may also be selectively positioned ashore as part of the overall PWRR, as authorized in reference 1. Such FILLs are currently maintained at NSC Norfolk (LANTFILL) and NSD Subic Bay (PACFILL). These FILLs ashore are identified to the PWRR project PLØ.

FIGURE I

STOCK OF A GIVEN FILL LINE ITEM IN A GIVEN AFS




NOT TO SCALE

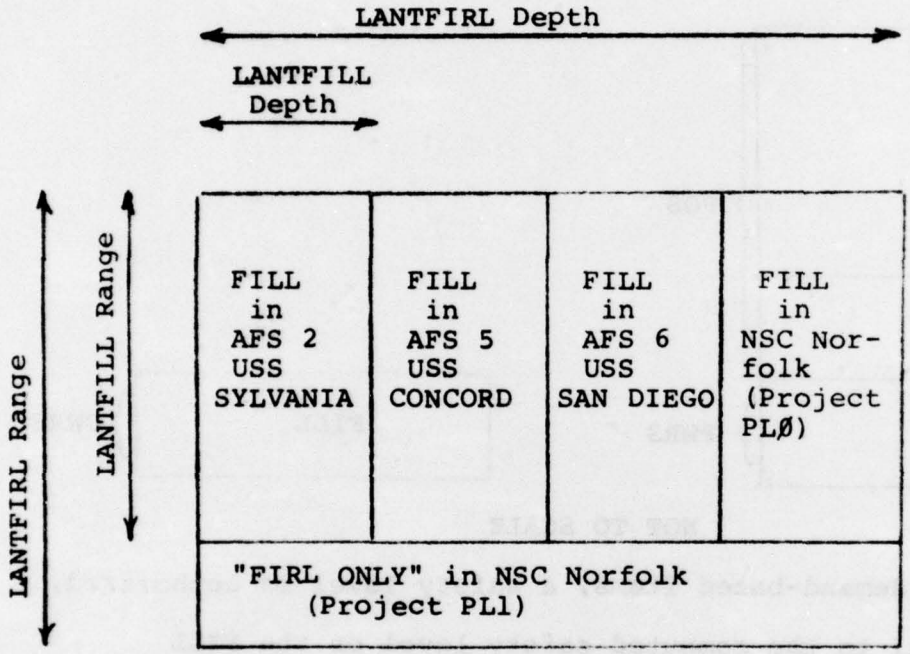
NOTE: For demand-based items, a safety level is authorized, equal to the computed safety level or the FILL quantity, whichever is greater.

FIGURES II and III illustrate the relationship between FIRL and FILL ranges and depths. As illustrated, a portion of the FIRL range is outside the FILL range. Those items are identified as "FIRL ONLY" and when available, are positioned ashore in accordance with reference 1. "FIRL ONLY" requirements are identified to the PWRR project PL1. This project is not fully funded. Available assets are

currently positioned at NSC Norfolk and NSD Subic Bay.

**FIGURE II**

**POSITIONING OF FLEET ISSUE REQUIREMENTS LIST FOR ATLANTIC FLEET (LANTFIRL)**

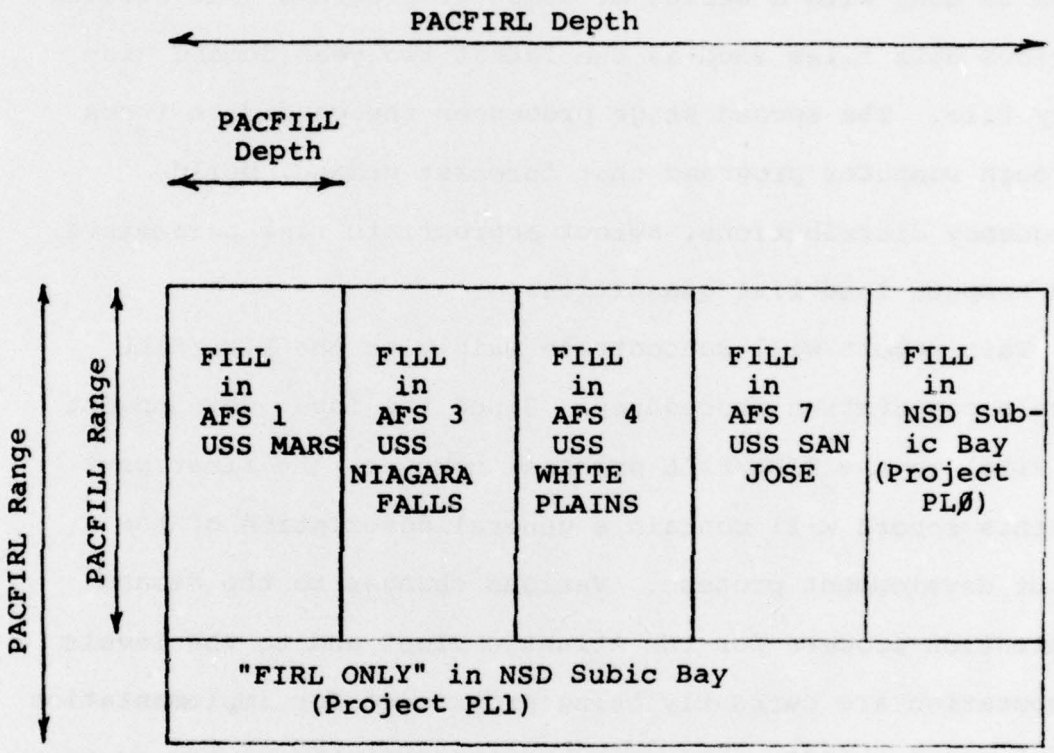



NOT TO SCALE

NOTE: Location of FIRL/FILL material ashore is subject to change and is illustrative only.

FIGURE III

POSITIONING OF FLEET ISSUE REQUIREMENTS LIST FOR PACIFIC FLEET (PACFIRL)




NOT TO SCALE

NOTE: Location of FIRL/FILL material ashore is subject to change and is illustrative only.

The development of the FIRL/FILL consists of two major stages: input development and levels computation. The input development stage builds the candidate records. This is done with a series of computer programs that utilize various data files such as the latest two year demand history file. The second stage processes the candidate items through computer programs that forecast demand, build frequency distributions, select appropriate risk parameters, and compute load list quantities.

This report will concentrate mainly on the FIRL/FILL levels computation procedures. Since the input development is vital to the FIRL/FILL process, however, the first part of this report will contain a general description of the input development process. Various changes to the demand collection process for the Atlantic Fleet and to the levels computation are currently being programmed for implementation by 31 January 1977. This report describes the system as it will operate after these changes are implemented.

## II. DESCRIPTION

A. INPUT DEVELOPMENT. The FIRL/FILL is a demand-based load list. As such, the actual demand data reported by various activities are the driving force behind the FIRL/FILL development. A two year Master Demand File is main-

tained at FMSO. This file consists of MLSF (Mobile Logistics Support Force) demands reported monthly to FMSO and stock point demands from surface ships, as extracted monthly from the stock point requisition status files. The MLSF and stock point demands include: (1) industrial ship's demands in support of repairs for other ships, (2) fleet demands for first echelon stock replenishments, and (3) ship's own use demands. The stock point data represent items required by the non-deployed surface ships and deployed surface ship requirements that were passed to the stock point. In building the FIRL/FILL Candidate File, only fleet issue demands are considered. Demand is extracted in terms of deployed demand and expanded demand.

In the Pacific Fleet, the deployed demand data base consists of all issues reported by the four Pacific AFSs and fleet issue demand reported by NSD Subic Bay, NSD Guam, and NSD Yokosuka. Fleet issue demands reported for AO deck-load and HULL (High Usage Load List) items are also included. The expanded demand data base consists of the deployed demands plus all stock point fleet issue demands from non-deployed (3rd Fleet) ships. The stock point demands are collected from NSC San Diego, NSC Oakland, and NSC Pearl Harbor.

In the Atlantic Fleet, the deployed demand data base

consists of all issues by the three Atlantic AFSs and all stock point demands from deployed surface ships. Fleet issue demands reported for AO deckload and HULL items are also included. The expanded demand data base consists of deployed demands plus all stock point fleet issue demands from non-deployed (2nd Fleet) ships. The stock points demands are collected from NSC Norfolk, NSC Charleston, and NAS Jacksonville (NAVSTA Mayport).

Demands for I cog material (publications and forms) are purged from the demand file. These I cog demands are put on a separate file and sent to the NPFC (Navy Publications and Forms Center) in Philadelphia. The NPFC computes the load list quantities for forms. Publications are not carried on the FIRL/FILL.

More detailed information on the FIRL/FILL input development can be found in references 3 and 4. The role of the deployed and expanded demand data bases in the levels computation process is discussed in the following section.

B. LEVELS COMPUTATION PROCESS.

1. Range Determination. As stated in reference 1, the FIRL/FILL consists of three categories of items -- APA, NSA-ER (Navy Stock Account-Equipment-Related), and NSA-NER (NSA-non-equipment-Related). The NSA ER/NER coding is based on the item's FSG (Federal Supply Group). APPENDIX B

lists the FSGs used to code items as equipment-related. All APA items are considered equipment-related.

The FIRL/FILL is a demand-based load list. Unless an override is applied, an item can make the FIRL/FILL only if it passes a series of range criteria which are based on frequency of demand over the most recent two years.

FIRL items are items that pass a specified FIRL range criterion. More specifically, a FIRL item must have an expanded demand frequency of at least eight in a two year period. An item that fails to pass the FIRL range criterion is called a non-load list item. These items are not included in the FIRL.

Those items in the FIRL range that also pass a more restrictive FILL range criteria are called FILL items. The FILL range criteria are a combination of two criteria. A FILL item must have had an expanded demand frequency at least as great as a specified value (RC1) and a deployed demand frequency at least as great as a second specified value (RC2). The methodology for determining the specified values will be discussed later in the report. An ER item that passes the FIRL range criterion, but not the FILL range criteria, is called a "FIRL ONLY" item. An NER item that passes the FIRL range criterion, but not the FILL range criteria, is considered a non-load list

item since reference 1 excludes NER items from the "FIRL ONLY" range. These NER items are, therefore, also excluded from the total FIRL.

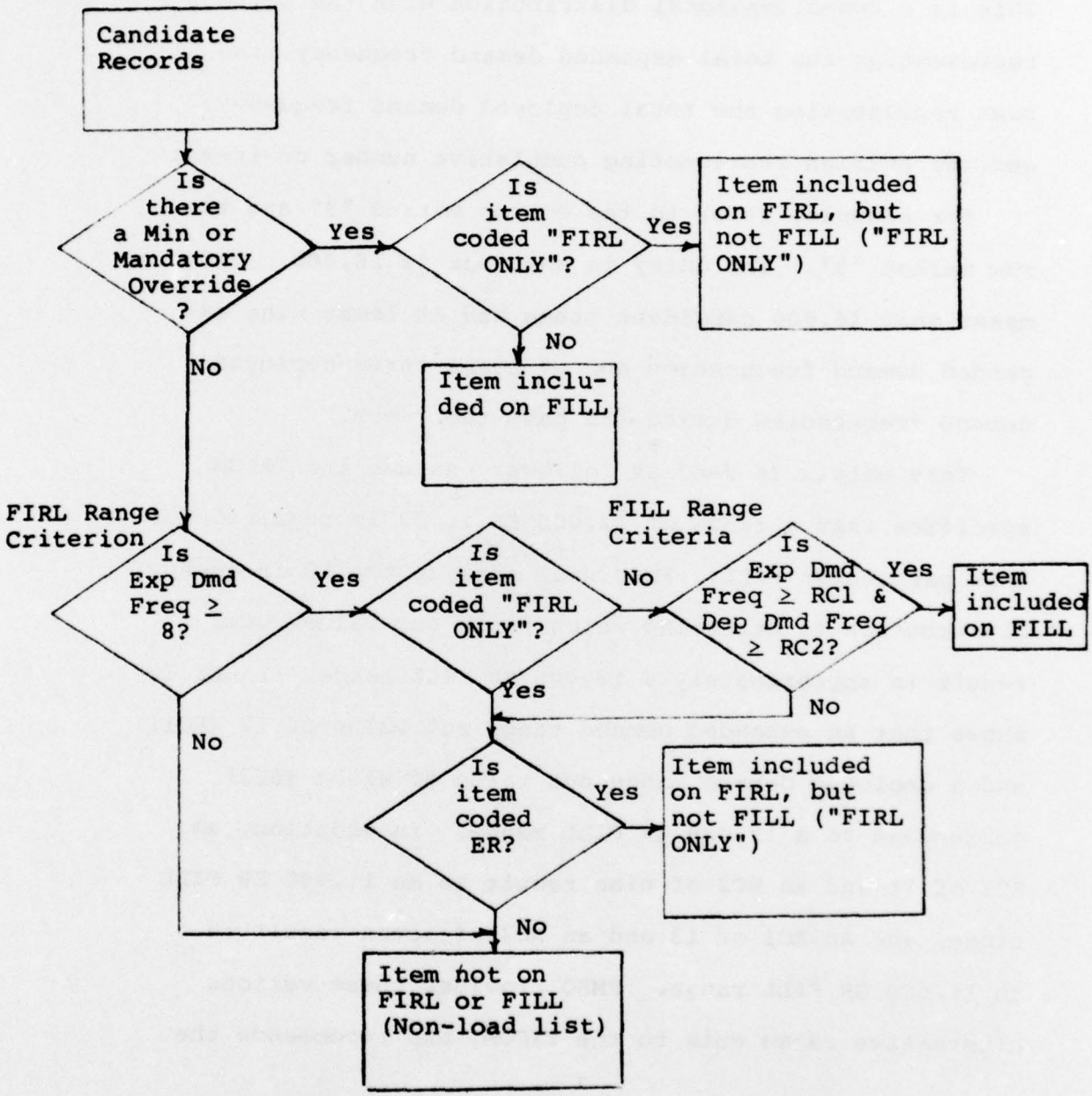
As noted earlier, the item range determined by the above criteria may be modified by exclusion overrides and minimum or mandatory quantity overrides. Furthermore, items may be excluded from the FILL but considered for the FIRL through assignment of a "FIRL ONLY" code. The logic described above is diagrammed in FIGURE IV.

The FILL range criteria are determined from frequency distributions which are based on the most recent two year demand history of the candidate items. Items with exclusion, mandatory, or minimum override assignments are not included in these distributions. The remaining items are included only if they passed the FIRL range criteria.

In general, the TYCOM (Type Commander) selects the total number of ER and NER items to be included on the FILL. FMSO develops separate frequency distributions for ER and NER items. These distributions are based on demand frequencies over the most recent two year period. FMSO selects from these distributions the ER/NER FILL range cut values that result in the recommended FILL range. The TYCOM recommends the desired FILL composition to CNO (OP-04) for approval. The ER range cut is used on both

FIGURE IV

FIRL/FILL FLOW CHART



NSA and APA items.

TABLE I displays a sample frequency distribution similar to the one used by FMSO in the FIRL/FILL process. This is a two-dimensional distribution with the columns representing the total expanded demand frequency, the rows representing the total deployed demand frequency, and the entries representing cumulative number of items.

For example, refer to the column marked "9" and the row marked "3". The entry in that box is 16,000. This means that 16,000 candidate items had at least nine expanded demand frequencies and at least three deployed demand frequencies during the past two years.

This matrix is used as follows: assume the TYCOM specifies that a range of 12,000 ER items is required for this particular FILL. FMSO will analyze the ER frequency distribution to determine which range cut values will result in approximately a 12,000 ER FILL range. TABLE I shows that an expanded demand range cut value of 12 (RC1) and a deployed demand range cut value of eight (RC2) correspond to a 12,020 ER FILL range. In addition, an RC1 of 11 and an RC2 of nine result in an 11,900 ER FILL range, and an RC1 of 13 and an RC2 of seven result in an 11,600 ER FILL range. FMSO provides these various alternative range cuts to the TYCOM, who recommends the

TABLE I

SAMPLE ER FREQUENCY DISTRIBUTION

| TOTAL DEPLOYED DEMAND FREQUENCY (RC2) | TOTAL EXPANDED DEMAND FREQUENCY (RC1) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 0 | 25,000 | 22,040 | 20,500 | 18,000 | 15,100 | 14,000 | 13,000 |
| 1 | 24,000 | 20,000 | 18,000 | 16,000 | 14,900 | 13,806 | 12,470 |
| 2 | 21,000 | 18,000 | 16,800 | 15,000 | 14,450 | 13,700 | 11,240 |
| 3 | 18,000 | 16,000 | 14,600 | 14,300 | 14,100 | 13,200 | 10,900 |
| 4 | 17,000 | 15,000 | 14,200 | 14,000 | 13,900 | 12,800 | 10,500 |
| 5 | 16,000 | 14,800 | 14,000 | 13,700 | 13,400 | 12,500 | 10,000 |
| 6 | 15,300 | 14,000 | 13,400 | 13,250 | 13,000 | 11,750 | 9,800 |
| 7 | 15,000 | 13,900 | 13,200 | 13,000 | 12,800 | 11,600 | 9,450 |
| 8 | 14,000 | 13,500 | 13,000 | 12,840 | 12,020 | 10,870 | 9,170 |
| 9 | 12,600 | 12,600 | 12,400 | 11,900 | 10,950 | 9,870 | 8,910 |
| 10 | 9,700 | 9,700 | 9,700 | 9,500 | 9,250 | 9,000 | 8,870 |

range and range cut values to CNO (OP-04) for approval.

Further information on the range determination can be found in references 5 and 6.

2. Depth Computation. The FIRL/FILL depth computation process consists of computer programs that: (a) forecast expected demand, (b) select appropriate risk parameters, and (c) compute load list quantities. Each of these pro-

grams is discussed below. More detailed information can be found in references 5, 6, and 7.

a. Forecasting Expected Demand. This forecast of expected demand is based on the latest two year demand history for each candidate item. The program computes a demand forecast called a QAD (Quarterly Average Demand) and a standard deviation of quarterly demand ($\sigma$) for each candidate item.

The QAD is a simple average of experienced demand.

$$QAD = \frac{\text{Total Demand Quantity over past 8 Quarters}}{8}$$

The standard deviation is computed as the square root of the variance of demand as follows:

$$\sigma = \sqrt{\frac{\text{Sum of } (D_i - QAD)^2 \text{ over last 8 Quarters}}{7}}$$

where

$D_i$ = demand quantity by quarter

QAD = quarterly average demand

The quarterly average demand and standard deviation of quarterly demand are computed for both expanded demand and deployed demand. The quarterly average demand provides an estimate of the expected demand for a 90 day period,

while the standard deviation provides a measure of how much the demand fluctuates from quarter to quarter.

b. Selecting Appropriate Risk Parameters. This program is a parameter selection model which is used to determine the risk parameter value necessary to attain the effectiveness goals stated in reference 1. Reference 1 specifies separate requisition effectiveness goals for NSA-ER, NSA-NER, and APA items.

The risk of stockout controls the depth of an item and thus the predicted effectiveness for the load. The acceptable risk of stockout is defined as:

$$\text{Risk} = \frac{\lambda \times C \times A}{QAD}$$

where

$\lambda$ (Lambda) = control parameter

C = item unit price

A = item average requisition size = total two year demand quantity divided by the total number of requisitions over the same period

QAD = item quarterly average demand

The risk is constrained to a maximum of 0.97725 (about 98%) and a minimum of 0.02275 (about 2%).

The Lambda value ($\lambda$) is the control parameter in the risk equation. Unit Price, Average Requisition Size, and

Quarterly Average Demand are constants for each item for a particular time period. Therefore, varying the Lambda value is the only way to control the risk of stockout which in turn controls requisitions effectiveness.

Conceptually, the risk equation works this way: risk is the complement of protection. In other words, 60% protection is the same as 40% risk; 90% protection is the same as 10% risk, etc. If higher protection is the goal, then risk should be decreased by lowering the Lambda value. Conversely, if a lower investment level is desired, the Lambda value should be raised. In general, higher protection results in higher predicted effectiveness, since an item with a high protection value would have a greater depth computed than it would if it had low protection, all other factors being equal.

The purpose of the parameter selection model is essentially to determine the Lambda values which result in predicted effectiveness to meet the goals in reference 1. Several values of Lambda may be tested to attain an acceptable value for Lambda.

The model described above is called a variable protection model. The risk, and thus protection, may be different across the candidate items because of differences in item characteristics. More specifically, high cost/low

demand items will have relatively lower protection than low cost/high demand items.

This program also has the option of computing risks based on a units effectiveness goal rather than requisitions. Previous loads have used the units effectiveness option. However, the requisitions effectiveness option will be used as of 1 January 1977, in accordance with reference 1. The option also exists to run the program as a fixed protection model. In that model, every item will have the same risk, and thus the same protection, regardless of unit price or demand frequency. The variable protection option is currently being used because it satisfies the OPNAV guidance at a lower total cost by emphasizing availability of low cost items. APPENDIX C provides cost comparisons.

c. Computing Load List Quantities. FIRL depth computations are based on the Normal distribution which utilizes an item's computed risk, predicted wartime quarterly average demand ($QAD_M$), and predicted wartime standard deviation of quarterly demand ($\sigma_M$). An item's quarterly average demand and standard deviation of quarterly demand are based on actual demand and are augmented by the fleet support factor to obtain estimated wartime requirements. This factor, currently set by OPNAV at 1.5, represents the estimated increase in demand under mobilization conditions. In symbols, an item's QAD and $\sigma$ are modified as follows:

$$QAD_M = QAD \times 1.5$$

$$\sigma_M = \sigma \times \sqrt{1.5}$$

The risk used in the normal distribution is based on the Lambda value determined from the parameter selection model. ER, NER, and APA items may have separate Lambda values. The quantity computed from the Normal distribution is called the FIRL quantity. If the item is a FILL item, this FIRL quantity is divided by the number of FILL activities -- usually four in the Atlantic and five in the Pacific. The new quantity is called the FILL quantity. Any item passing the FILL range cut will have a minimum FILL quantity of one.

After the FIRL or FILL depth is determined, an item's new load list quantity is compared with its old load list quantity. If the difference between the two quantities is relatively small, the old load list quantity is used rather than the new one. This is done to minimize the workload resulting from numerous depth changes. The load list quantity is then constrained to be at least a dollar's worth of stock. The load list quantity can also be changed through the use of a mandatory override, maximum override, or minimum override.

APPENDIX D demonstrates the FIRL and FILL depth

computations.

## III. SUMMARY

The FIRL/FILL is a demand-based load list that is designed in accordance with reference 1. That instruction controls the range of items to be included and specifies separate requisitions effectiveness goals for NSA-ER, NSA-NER, and APA items.

The development of the FIRL/FILL consists mainly of an input development stage and a levels computation stage. The input development process extracts both deployed demand and expanded (deployed plus CONUS) demand. The levels computation process consists of a range determination stage and a depth computation stage.

The FILL range is determined from frequency distributions for ER and NER items. A FIRL item must have had an expanded demand frequency of at least eight in the past two years. This is called the FIRL range criterion. Those items in the FIRL range that also pass more restrictive FILL range criteria are called FILL items. Equipment-related items that pass the FIRL range criterion, but not the FILL range criteria are called "FIRL ONLY" items. There are no "FIRL ONLY" non-equipment-related items. The item range discussed above may be modified by overrides.

A variable protection model is used to compute the risk of stockout for each FIRL item. The depth computations are based on the Normal distribution. The quantity computed from the Normal distribution is called the FIRL quantity. If the item is a FILL item, this FIRL quantity is divided by the number of FILL activities to obtain the FILL quantity. FILL items are positioned on the AFS and at designated FILL shore activities.

A separate FIRL/FILL is computed once a year for the Atlantic and Pacific fleets.

## APPENDIX A: REFERENCES


1. OPNAVINST C4080.11A w/Change #2
2. OPNAVINST 4441.12A w/Change #2
3. SSDS (Supply System Design Specification), Application/ Operation E22, Mobile Logistics Support Force Demand
4. Application/Operation E22, DPS-2 series
5. SSDS, Application/Operation D17, FIRL/FILL Range and Depth Decision Rules
6. DPS-2, E15AZ, FIRL/FILL Forecast and Frequency Distribution
7. DPS-2, E15BW, FIRL/FILL Simulation and Levels Setting

## APPENDIX B: EQUIPMENT-RELATED ITEM IDENTIFICATION

The following is a list of FSGs (Federal Supply Groups). An NSA candidate item assigned with any one of the FSGs marked with an asterisk (*) is coded as an equipment-related item in the FIRL/FILL process. All other NSA items are coded as non-equipment-related.

| FSG | TITLE |
|---|---|
| *10 | Weapons |
| 11 | Atomic ordnance |
| *12 | Fire control equipment |
| 13 | Ammunition and explosives |
| *14 | Guided missiles |
| 15 | Aircraft and airframe structural components |
| 16 | Aircraft components and accessories |
| *17 | Aircraft launching, landing, and ground handling equipment |
| 18 | Space vehicles |
| *19 | Ships, small craft, pontoons, and floating docks |
| *20 | Ship and marine equipment |
| 21 | Unassigned |
| 22 | Railway equipment |
| 23 | Motor vehicles, trailers, and cycles |
| 24 | Tractors |
| 25 | Vehicular equipment components |
| 26 | Tires and tubes |
| 27 | Unassigned |
| *28 | Engines, turbines, and components |
| *29 | Engine accessories |
| *30 | Mechanical power transmission equipment |
| *31 | Bearings |
| 32 | Woodworking machinery and equipment |
| 33 | Deleted |
| *34 | Metalworking machinery |
| 35 | Service and trade equipment |
| 36 | Special industry machinery |
| 37 | Agricultural machinery and equipment |
| 38 | Construction, mining, excavating, and highway maintenance equipment |
| 39 | Materials handling equipment |

| FSG | TITLE |
|---|---|
| 40 | Rope, cable, chain, and fittings |
| *41 | Refrigeration and air conditioning equipment |
| *42 | Fire fighting, rescue, and safety equipment |
| *43 | Pumps and compressors |
| *44 | Furnace, steam plant, and drying equipment; and nuclear reactors |
| *45 | Plumbing, heating, and sanitation equipment |
| *46 | Water purification and sewage treatment equipment |
| 47 | Pipe, tubing, hose, and fittings |
| *48 | Valves |
| 49 | Maintenance and repair shop equipment |
| 50 | Unassigned |
| 51 | Hand tools |
| 52 | Measuring tools |
| 53 | Hardware and abrasives |
| 54 | Prefabricated structures and scaffolding |
| 55 | Lumber, millwork, plywood, and veneer |
| 56 | Construction and building materials |
| 57 | Unassigned |
| *58 | Communication equipment |
| *59 | Electrical and electronic equipment components |
| 60 | Unassigned |
| *61 | Electric wire, and power and distribution equipment |
| 62 | Lighting fixtures and lamps |
| *63 | Alarm and signal systems |
| 64 | Unassigned |
| 65 | Medical, dental, and veterinary equipment and supplies |
| *66 | Instruments and laboratory equipment |
| 67 | Photographic equipments |
| 68 | Chemicals and chemical products |
| 69 | Training aids and devices |
| 70 | Unassigned |
| 71 | Furniture |
| 72 | Household and commercial furnishings and appliances |
| 73 | Food preparation and serving equipment |
| 74 | Office machines and data processing equipment |
| 75 | Office supplies and devices |
| 76 | Books, maps, and other publications |
| 77 | Musical instruments, phonographs and home-type radios |
| 78 | Recreational and athletic equipment |
| 79 | Cleaning equipment and supplies |
| 80 | Brushes, paints, sealers and adhesives |
| 81 | Containers, packaging, and packing supplies |
| 82 | Unassigned |
| 83 | Textiles, leather and furs |

| FSG | TITLE |
|---|---|
| 84 | Clothing and individual equipment |
| 85 | Toiletries |
| 86 | Unassigned |
| 87 | Agricultural supplies |
| 88 | Live animals |
| 89 | Subsistence |
| 90 | Unassigned |
| 91 | Fuels, lubricants, oils, and waxes |
| 92 | Unassigned |
| 93 | Nonmetallic fabricated materials |
| 94 | Nonmetallic crude material |
| 95 | Metal bars, sheets and shapes |
| 96 | Ores, minerals, and their primary products |
| 97 | Unassigned |
| 98 | Unassigned |
| 99 | Miscellaneous |

NOTE: There is currently a proposal under study that would further refine the ER breakout by use of the FSC (Federal Supply Class). However, the FSCs have not yet been fully defined. This appendix, therefore, lists the FSGs as currently used.

## APPENDIX C: FIXED PROTECTION VS VARIABLE PROTECTION

For purposes of comparison, several PACFIRL simulation runs were made using fixed protection goals of 15%, 35%, 65% and 85%; and one run using a variable protection goal of 90%. The following table displays the results of these simulation runs:

PACFIRL SIMULATIONS

| VALUE OF PROTECTION | NR OF CANDIDATES | FIRL RANGE | FIRL $ VALUE (MILLIONS) | FILL RANGE | FILL $ VALUE (MILLIONS) | PREDICTED PROTECTION |
|---|---|---|---|---|---|---|
| 15% | 153,443 | 26,922 | $ 7.1 | 10,838 | $ 1.2 | 35.5% |
| 35% | 153,443 | 26,922 | $13.2 | 10,838 | $ 2.3 | 56.8% |
| 65% | 153,443 | 26,922 | $66.2 | 10,838 | $12.3 | 81.0% |
| 85% | 153,443 | 26,922 | $112.3 | 10,838 | $21.1 | 91.9% |
| 90% Variable Protection Goal | 153,443 | 26,922 | $ 9.7 | 10,838 | $ 1.6 | 90.3% |

## APPENDIX D: SAMPLE FIRL/FILL DEPTH COMPUTATIONS

This section displays the depth computations for several sample items. These examples show the significant impact that unit price and standard deviation have on the computed load list quantity. The same Lambda value ($\lambda = 2.5$) was used in each of the sample computations in order to facilitate comparisons between the computations. In actual practice, the Lambda values vary across item categories (NSA-ER, NSA-NER, APA). In other words, all NSA-ER items would have the same Lambda value, but the NSA-NER items would probably have a different Lambda value. APA items could have still a third Lambda value. In addition, the Lambda value varies from one load to another, as can be seen from TABLE I.

TABLE I

EXAMPLES OF LAMBDA VALUES FROM PREVIOUS LOADS

| | 1976 Atlantic FILL | 1977 Pacific FILL |
|---|---|---|
| NSA-ER and APA | $\lambda = 3.0$ | $\lambda = 3.3$ |
| NSA-NER | $\lambda = 60.0$ | $\lambda = 1.0$ |

NOTE: In these previous loads, APA items were grouped with the NSA-ER items and the same Lambda value was used

for both categories.

Sample items A, B, C, and D show the impact on the load list quantity by varying the unit price for high demand items. The calculations for sample items E, F, and G show the impact on the load list quantity for low demand items. The computations for sample items H, I, and J show that the load list quantity is greatly influenced by the standard deviation of quarterly demand.

The standard deviation is probably the most important variable in the depth computation routine. Since demand patterns are extremely random, the standard deviation will vary widely from one item to another. Therefore, items with similar unit prices and average demands may have vastly different levels computed for them because of their random demand patterns.

All of the sample items are assumed to have passed the FILL range cut. Overrides are not considered. The sample depth computations are summarized in TABLE II below.

TABLE II

SUMMARY OF SAMPLE ITEM DEPTH COMPUTATIONS
($\lambda$ = 2.5; FLEET SUPPORT FACTOR = 1.5; NR FILLs = 4)

| SAMPLE ITEM | QAD | STANDARD DEVIATION | UNIT PRICE | AVG REQN SIZE | FIRL QTY | FILL QTY |
|---|---|---|---|---|---|---|
| A* | 100 | 50 | $ .01 | 20 | 272 | 68 |
| B | 100 | 50 | .20 | 20 | 228 | 57 |
| C | 100 | 50 | 1.00 | 20 | 152 | 38 |
| D | 100 | 50 | 5.00 | 20 | 28 | 7 |
| E | 2 | 2.5 | $ .01 | 1 | 8 | 2 |
| F | 2 | 2.5 | .20 | 1 | 4 | 1 |
| G | 2 | 2.5 | 1.00 | 1 | 4 | 1 |
| H | 100 | 80 | $ .20 | 20 | 276 | 69 |
| I | 100 | 130 | .20 | 20 | 352 | 88 |
| J | 100 | 240 | .20 | 20 | 524 | 131 |

*Attachment 1 contains the detailed FIRL/FILL depth computations for sample item A. The load list quantity was computed in a similar manner for the other sample items.

## SAMPLE ITEM A

| | | | |
|---|---|---|---|
| Unit Price | = $.01 | Fleet Support Factor | = 1.5 |
| Quarterly Average Demand (QAD) | = 100 | Lambda Value ($\lambda$) | = 2.5 |
| | | Number FILLs | = 4 |
| Standard Deviation of QAD($\sigma$) | = 50 | | |
| Average Requisition Size | = 20 | | |

Compute Risk/Protection

$$\text{Risk} = \frac{\lambda \times (\text{Unit Price}) \times (\text{Average Requisition Size})}{\text{QAD}}$$

$$= \frac{2.5 \times .01 \times 20}{100} = .005$$

Since Risk < 0.02275, set Risk to 0.02275

Protection = 1 - Risk = 0.97725

Adjust QAD and $\sigma$ to obtain Estimated Wartime Requirements

Mobilization QAD = $QAD_M$ = QAD x Fleet Support Factor

$$QAD_M = 100 \times 1.5 = 150$$

Mobilization Standard Deviation = $\sigma_M$ = $\sigma$ x Fleet Support Factor

$$\sigma_M = 50 \times \sqrt{1.5} = 61$$

Attachment 1 to
APPENDIX D

Compute Load List Quantity

$LLQ = QAD_M + TVAL \times \sigma_M$

TVAL = 2.0 when Protection = 0.97725

Therefore, LLQ = 150 + 2.0 x 61 = 272.

FILL Quantity = LLQ/Number of FILLs = 272/4 = 68.

Total FILL Quantity = Number of FILLs x FILL Quantity = 272.

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13. ABSTRACT
Upon the outbreak of hostilities, it is anticipated that ships on station and those immediately ordered to sea will experience a period of support from own stores and those of the Mobile Logistics Support Force. To prepare for this possibility, a projected demand-based material requirement is computed annually to support surface ships in a geographical area for a stipulated period. The geographical area quantity is subdivided into individual load lists for combat stores ships and for selected, strategically located shore activities. For these purposes, the secondary items of supply are divided into three categories: APA, NSA-equipment-related, and NSA Non-equipment-related. A model determines range of items to be carried and variable depth of stock by line item, to obtain a projected supply effectiveness goal. Sample calculations are provided.

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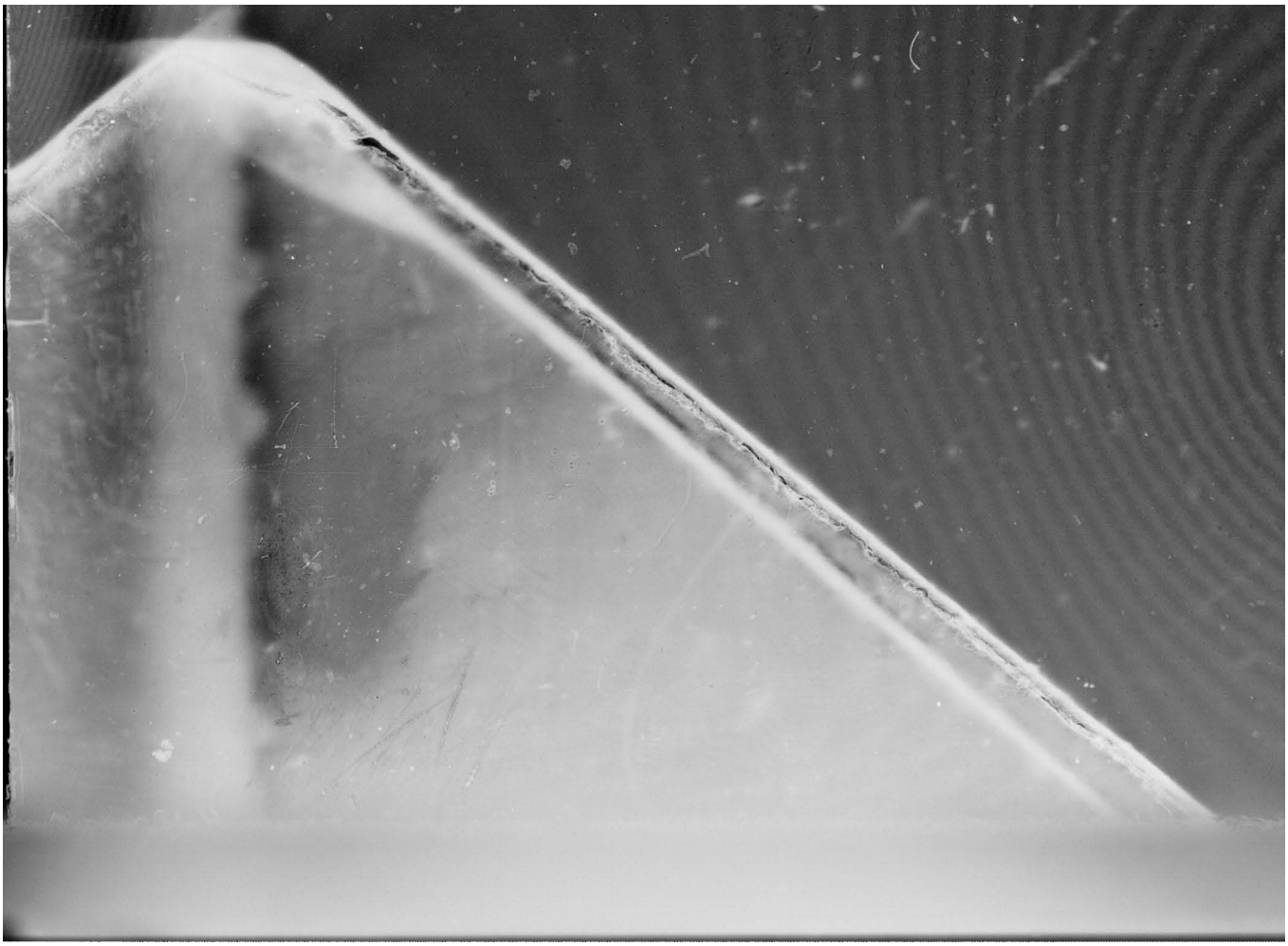
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